Tracheotomy in Bulbar Poliomyelitis

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SUMMARY

Tracheotomy was performed on 181 of 351 patients with bulbar poliomyelitis. The essential indication for tracheotomy was secretional obstruction of the respiratory tract that could not be relieved by postural drainage and aspiration.

Comparison of mortality rates in this series with those of previous series in which tracheotomy was not done in the presence of similar indications, suggests that the procedure may be life-saving in a considerable percentage of cases.

Outside the respirator the tracheotomy can be done with or without the aid of the bronchoscope or endotracheal anesthesia tube. When done inside the opened respirator the Bennett flow-sensitive positive pressure machine should be used to supply oxygen to the patient while the respirator is not operating.

TRACHEOTOMY seems to have been used first in the treatment of poliomyelitis in 1931. Wilson[11] reported using it successfully at that time in a number of patients with pharyngeal paralysis in preventing choking attacks and aspiration of secretions into the bronchial tree. Davison[3] in 1936 stated that tracheotomy might be necessary in bulbar poliomyelitis. Galloway[4] in 1943 reported that tracheotomy was life-saving in two of three patients with poliomyelitis and respiratory difficulty not relieved by postural drainage or aspiration of secretions incapable of being swallowed. In 1945 Nelson-Jones[8] and Williams reported the use of tracheotomy in one case of bulbar poliomyelitis and Glaser[6] also reported its use in a small number of cases. During these years tracheotomy seems to have been used only in a relatively small number of patients and then only rather late in instances of severe secretional obstruction of the airway. However, in the 1946 epidemic in Minneapolis, Priest[9] reported on the use of tracheotomy in 75 of approximately 400 cases of bulbar poliomyelitis. In this series tracheotomy was used not only as a lifesaving measure but as a prophylactic procedure to prevent anoxia, atelectasis and pneumonia. Of the 75 patients tracheotomized, 29 survived, and of these 19 seemed to owe their lives directly to tracheotomy.

As a result of the successes in that large series, tracheotomy was performed on 14 of the 129 patients with bulbar poliomyelitis treated in the communicable disease unit of the Los Angeles County General Hospital during 1946. Seven of the 14 died. Eight tracheotomies were performed in 1947 and four of the patients died, but in the severe epidemic of 1948 more than 200 tracheotomies were performed in this hospital in a series of more than 600 patients with bulbar poliomyelitis.

During 1948 there were 3,135 cases of poliomyelitis in Los Angeles County with a mortality rate slightly over 4 per cent. The Los Angeles County health officer reported that there were 600 patients with the bulbar type of the disease; 280 of them required respirator care and 230 of them needed tracheotomy, making this the most serious as well as largest epidemic in the history of the country. The authors reviewed the records of 388 of the cases of bulbar poliomyelitis in this series. In this group 198 patients (51.0 per cent) received tracheotomy. Experiences and results in these cases form the basis for this presentation, which is made in an attempt to outline indications for and technique of performing tracheotomy in bulbar poliomyelitis.

INDICATIONS

Secretional obstruction of the respiratory tract is the outstanding indication for tracheotomy. Early in bulbar poliomyelitis, paralysis of the 9th and 10th cranial nerves results in secretions pooling in and obstructing the larynx because of the inability of the patient to swallow the secretions. Interference with the innervation of the larynx and increased secretions are additive factors. Early symptoms indicating bulbar polioymelitis are a weak or nasal voice and difficulty in swallowing. It is of interest that a very large number of the patients in this series also had early unilateral facial paralysis. Of course, many times the pooled secretions can successfully be aspirated by suction, but when the patient, despite suction, has periods of choking in which he becomes restless, irritable, apprehensive, or slightly cyanotic, tracheotomy is indicated.

Sometimes the patient is already comatose and cyanotic when first observed, because the secretions in the larynx and upper trachea are so great and thick that air cannot be drawn through them. In such cases immediate tracheotomy often permits successful aspiration of the secretions with prompt recovery from anoxia.

In another classification are patients in whom pooling of secretions is insufficient to cause laryngeal obstruction but in whom there is clinical or x-ray evidence indicating development of atelectasis, pneumonia, or pulmonary edema as a result of abnormal amounts of secretion in the lower airways. This pooling of secretions in the trachea and bronchi may result from the inability to cough and the loss

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of tussive squeeze because of paralysis of the intercostal muscles and the diaphragm. Furthermore, pulmonary edema and bronchial hypersecretion are a part of poliomyelitis. The development of this situtation is an indication for early tracheotomy in order that the tracheobronchial tree may be kept aspirated free of secretions.

Tracheotomy is frequently indicated for the patient who is already in a respirator, because the negative pressure created by the respirator in its inspiratory phase tends to pull the secretions downward from the larynx and thus cause atelectasis or "drowning in the patient's own secretions." The intrathoracic negative pressure is increased on inspiration by any obstruction at the laryngeal level either because of pooled secretions or vocal cord paralysis. Thus tracheotomy is indicated to afford safe aspiration of these secretions and to by-pass the laryngeal obstruction causing the increasing negative inspiratory pressure.

Because of this action by the respirator, in the past many patients with bulbar poliomyelitis who developed respiratory difficulty because of intercostal and diaphragmatic paralysis could not survive if placed in the respirator. Here, then, is another indication for tracheotomy; that is, in the patient with bulbar poliomyelitis who up to a point has not been distressed by secretions, but who ultimately must be placed in a respirator.

TECHNIQUE

Tracheotomy for a patient with bulbar poliomyelitis is a complicated procedure if the patient is already in a respirator or if it is necessary that he be placed in a respirator immediately following this operation. Of 198 tracheotomies in the present series, 140 were done outside the respirator. Fourteen were done in an opened respirator, with an endotracheal anesthesia tube supplying oxygen from a manually operated anesthesia bag. The other 44 operations were performed in the opened respirator with a Bennett flow-sensitive positive pressure machine being substituted for breathing.

If the patient has never been in a respirator, tracheotomy is performed in the usual manner over a bronchoscope. Especially should the bronchoscope be used if the patient is a child. This technique should be used in most prophylactic or early tracheotomies.

If the tracheotomy is performed outside the respirator upon a patient who is to be placed in the machine immediately afterwards, the operation should be done over an endotracheal anesthesia tube or with the Bennett flow-sensitive positive pressure machine and mask supplying oxygen until the respirator can take over.

If the patient is already in a respirator and cannot breathe well enough or long enough to permit carrying out tracheotomy with the respirator turned off and opened up, the following techniques utilizing the Bennett positive pressure machine seem to be best:

1. Using the positive pressure mask, the patient can be pulled far down into the opened respirator but with the head still outside. With this technique, after tracheotomy the neck must be pulled up through the collar and the respirator closed and turned on as soon as the trachea is opened.

2. The patient's body, including the head, may be pulled down inside the opened respirator and the positive pressure mask applied through the collar opening of the respirator. As soon as the trachea is opened the positive pressure machine mask is removed and the oxygen tube attached directly to the tracheotomy tube and positive pressure continued. The patient's head and neck may then be drawn through the collar opening. This method seemed better to the authors and was the standard technique used in performing tracheotomies during the last part of the epidemic. Three strips of 3-inch flannel "soft restraint" material were used to roll the rubber collar of the respirator outward.

If the positive pressure machine did not keep the patient pink, the endotracheal anesthesia tube and oxygen breathing bag were substituted for it. This was occasionally necessary for patients with vocal cord paralysis or with acute laryngeal spasm.

The incision into the trachea itself should always be placed rather high in order to facilitate changing and cleaning of the tracheotomy tube and dressing the tracheotomy wound. The ideal site, in the authors' opinion, is the second tracheal ring. This ring almost always lies beneath the thyroid isthmus. Therefore, severance of the isthmus always should be planned. It was noted many times that the isthmus was swollen and congested.

A metal flange constructed to hold the rubber collar down and away from the tracheotomy wound makes care of the wound easier. Attempts to perform the tracheotomy outside the closed respirator with this flange in place were uniformly unsatisfactory, difficult and dangerous.

The tracheotomy tube used should be of the largest possible size, for two reasons: (1) in order that secretions may flow easily and without crusting, (2) to minimize the possibility that the tube might itself have the effect of tracheal obstruction and thus cause increased intrathoracic negative pressure during the inspiratory phase of the respirator.

POSTOPERATIVE CARE

Complete, detailed discussion of postoperative management of the tracheotomized patient in a respirator has been presented by West and Bower.[10] The respirator may be tipped head down for short intervals. Gentle suction with small rubber catheters with multiple openings is used through the tracheotomy tube to keep the airway cleared of secretion. Should the patient become cyanotic despite this suctioning, bronchoscopy through the tracheotomy is performed, repeatedly if necessary. Oxygen, bubbled through cool water, is allowed to flow into the tracheotomy tube at a rate of 2 to 3 liters per minute. Fluids are given at first intravenously and later by Levine tube into the gastrointestinal tract.

AUXILIARY POSITIVE PRESSURE MACHINE

Early in the epidemic the attending and resident staff of the communicable disease service noted that many of the tracheotomized respirator patients did not do as well as expected. That is, they did not seem to get enough air on inspiration, and repeated aspiration through the tracheotomy tube and even bronchoscopic aspiration did not control the presence of excessive secretion in the tracheobronchial tree. Thus atelectasis, pneumonia or pulmonary edema often resulted, sometimes causing death. It was theorized that in the tracheotomized patient the respirator did not create inspiratory aeration sufficient to combat the edema and hypersecretion present. Presented with the problem, a consulting engineer devised and built a machine which delivered air, oxygen or gaseous mixtures under positive pressure during inspiration through the tracheotomy tube.

Other investigators (Glaser,[6] Baker,[1] and Kubicek[7]) have described the use of oxygen under positive pressure during expiration, but clinical observation and a lessened mortality rate after the Bennett[2] positive pressure machine was routinely used proved the advantages of giving oxygen under positive pressure during inspiration, both in preventing hypoxia and in reducing bronchial secretions. The machine is so designed that on each expiration it is turned off so that the patient does not exhale against pressure. This mechanism is attached directly to the respirator so that its bellows contract as the respirator bellows expand; that is, positive pressure is applied through the tracheotomy tube during the inspiratory phase of respirator action. A portable flow-sensitive Bennett positive pressure machine with either face mask or an attachment for the tracheotomy tube was also constructed. This machine has an expiratory phase also, in which negative pressure is produced in the mask. It differs from other resuscitators, in that it is "flow-sensitive," that is, it cuts off automatically when the patient breathes for himself. This machine was used to breathe for the patient while the respirator was open and turned off to permit the placing of a tracheotomy tube.

RESULTS

Mortality: In the total of 388 cases of bulbar poliomyelitis reviewed, there were 101 deaths—28.8 per cent. Seventy-seven of these deaths were in the group of 198 patients who received tracheotomy. Thus there was a 38.8 per cent mortality rate in the tracheotomized group.

Complications: In the 198 tracheotomized patients there was one case of mediastinal emphysema and two cases of pneumothorax. There was troublesome bleeding from the tracheotomy wound in three patients, one of whom was receiving heparin.

Decanulization: The tracheotomy tube was usually not removed until the patient could swallow adequately. The average time for the return of adequate swallowing was 21½ days. The longest time for the return of swallowing and thus the removal of the tracheotomy tube was four and one-half months. However, many patients had a return of swallowing the day following the placing of the tube.

Stenosis: There was no instance of laryngeal stenosis occurring in this group of patients.

COMMENT

The total mortality rate of 28.8 per cent in this series of 388 cases of bulbar poliomyelitis seems gratifyingly small when compared to mortality rates in bulbar poliomyelitis in other epidemics. Inasmuch as in this epidemic tracheotomy was performed in 198 cases or 51.0 per cent of the patients with bulbar poliomyelitis, and since this procedure was the only major way in which treatment differs in this and previous epidemics, it is believed that early tracheotomy performed upon the previously mentioned indications was a great factor in lowering the death rate. Certainly those who performed the tracheotomies were convinced that many of the patients would have died of anoxia, atelectasis, pulmonary edema, or pneumonia if tracheotomy had not been done.

The staff members who were in constant attendance on these patients had a much better opportunity than the otolaryngologist to evaluate tracheotomy. Not only were they sure of its life-saving value, but almost all of the tracheotomies were done at their request upon their evaluation of the indications present. Two of the staff who saw all the cases (Bower and West) concluded that early tracheotomy cannot be over-stressed in the management of acute bulbar poliomyelitis and that this treatment saved at least half of the patients of a type who previously died.

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